

## Impact Crater in Coastal Patagonia?

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Impact craters are geological structures attributed to the impact of a meteoroid<sup>1</sup> on the Earth's (or other planet's) surface (Koeberl and Sharpton. 1999). The inner planets of the solar system as well as other bodies such as our moon show extensive meteoroid impacts (Gallant 1964, French 1998). Because of its size and gravity, we may assume that the Earth has been heavily bombarded but weathering and erosion have erased or masked most of these features. In the 1920's, a meteor crater (Mark 1987) was identified in Arizona and to this first finding the identification of a large number of impact structures on Earth followed (Hodge 1994). Shock metamorphic effects are associated with meteorite impact craters. Due to extremely high pressures, shatter cones are produced as well as planar features in quartz and feldspar grains, diaplectic glass and high-pressure mineral phases such as stishovite (French 1998).

Two types of impact craters can be morphologically distinguished: simple and complex (Koeberl and Sharpton. 1999). Simple craters are smaller size and have a depth-to-diameter ratio of 1:5 through 1:7. The general shape is that of a smooth bowl, and (on Earth) they are no bigger than four kilometers in diameter. Complex craters are larger. Gravity pulls the walls inward and downward so the material ejected by the impact rapidly fills part of the crater. The center of a complex crater is subjected to enormous pressure upon impact and yields but then coalesces forming a central peak. The resulting form is a central elevation surrounded by a deep ring, surrounded in turn by the ejecta ring. Complex craters are proportionally shallower than simple craters, with a depth-to-diameter ratio of 1:10 through 1:20. These ratios are modified on Earth by geologic processes such as erosion and mass motion. Hence, impact crater features are softened and eventually erased in the landscape (Koeberl and Sharpton. 1999).

Since the discovery of the Chicxulub Crater in Yucatan (Mexico) that is believed to be 64.8 millions years old, large terrestrial impact craters are being assigned great importance in geological history and biological evolution. In fact, this impact in Mexico appears to have happened in the transition between the Cretaceous and the Tertiary (K/T boundary) a time marked by the extinction of a large number of biological groups, notably the dinosaurs. This crater is 300 km in diameter. NASA scientists think that a meteorite between 10 and 20 kilometers in diameter must have produced such crater (Koeberl & Sharpton 1999). Impact craters have been identified in Northern and Central Argentina but to our knowledge there is no mention of Southern Argentina in the crater

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<sup>1</sup> Meteoroid = asteroid or comet.

inventory except for an early reference (Gallant 1964) of a large structure that we are currently investigating.

In this report we suggest that San Jorge Gulf (45-47.25°S; 65.5-66.7°W) is the emerged half of an impact crater of about 225 kilometers in diameter. Analysis of remote sensing data of its continental portion and acoustic studies of its marine portion seem to support our views. An initial analysis of Landsat Thematic Mapper scene 229/92 revealed a coastal structure of marked erosion figures that show the strong and prevalent westerly winds. These winds are most likely responsible for the filling of the crater.

Under the ocean water lay the morphologic clues for our hypothesis. Given the size of San Jorge Gulf and the Earth's gravity a complex crater structure must be expected. Eng. A. Madirolas has extracted relevant information from the bathymetry database of INIDEP's Laboratory of Hydroacoustics (unpublish data). See Fig. 1.

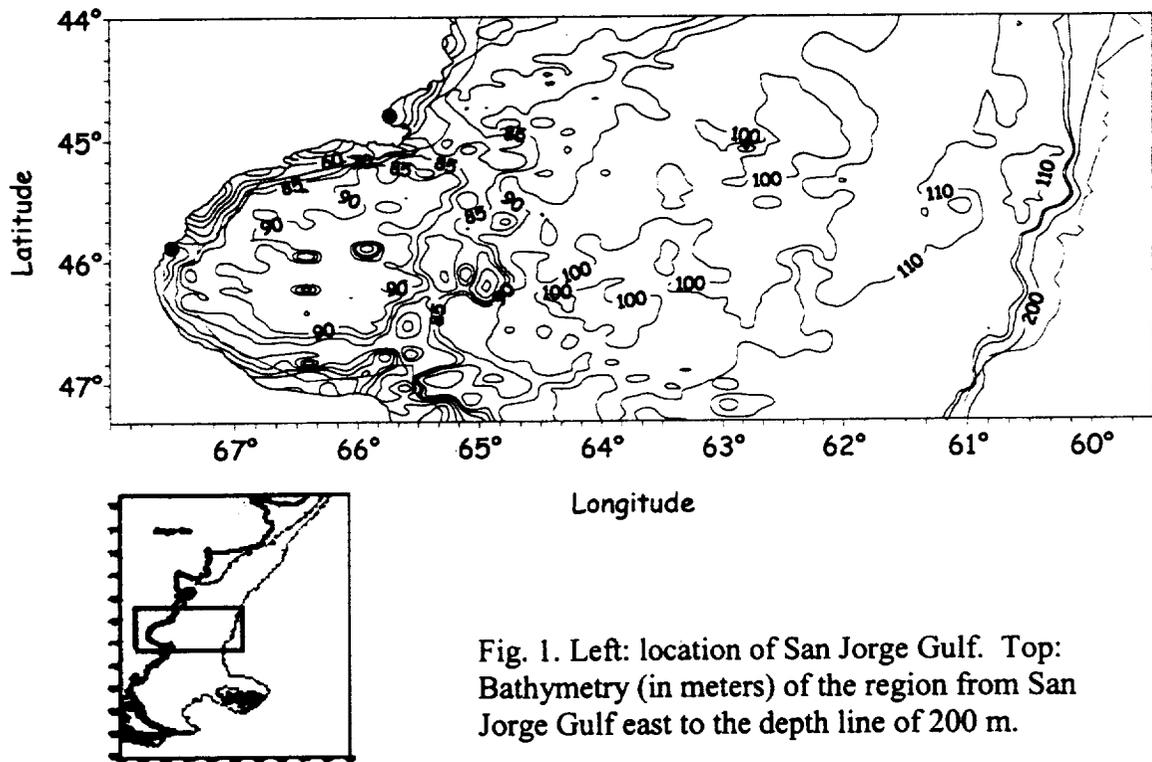


Fig. 1. Left: location of San Jorge Gulf. Top: Bathymetry (in meters) of the region from San Jorge Gulf east to the depth line of 200 m.

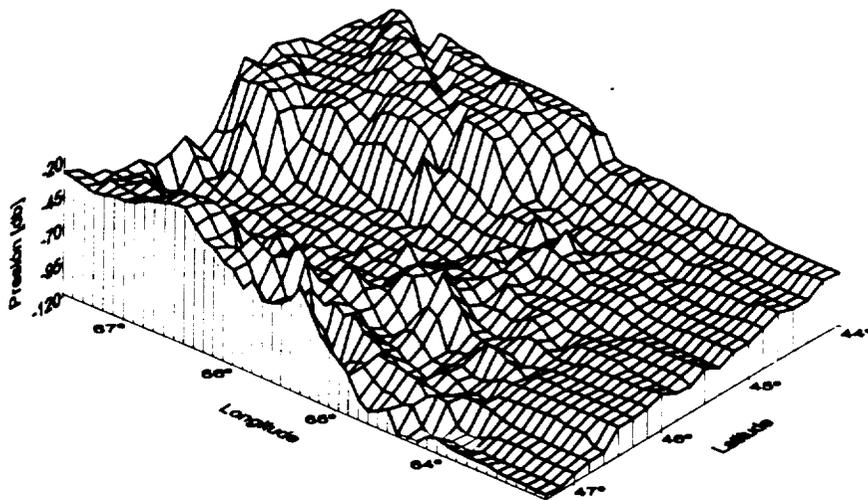


Fig 2. 3-D representation of the of the crater structure underwater in Gulf San Jorge. (Depth indicated in pressure units).

These are the results of our research: Figure 1 shows the location of San Jorge Gulf in coastal Argentina and describes the regional bathymetry. It shows a rough contour of the ring around the central elevation. Figure 2 displays the tri-dimensional image of the remnants of the crater. The indicative shape of the emerged part neatly matches the submerged part showing that there is a distinctive structure characteristic of an impact crater.

The evidence included in this report makes a strong case for further research of the San Jorge Gulf. Such research should include further analysis of INIDEP's Laboratory of Hydroacoustics database, use of other technology to cross-validate and enhance observations, further analysis of remote sensing data for the region, and geological studies including seismography, stratigraphy, mineralogy, and impact metamorphism.

According to Musacchio (1999), Tertiary deposits around Comodoro Rivadavia start with Salamanca Formation (Danian) near the seashore and toward North of Pico Salamanca. It is a 200 meters thick section. These sediments are sitting on the so-called 'Horizonte Madre' ('Mother Horizon'), "an enigmatic package formed by gray to dark gray clays, some times including small banks of sandstone or thin conglomerate at the base" (Musacchio 1999). The 'Horizonte Madre' lays on pyroclastic, Cretaceous rocks (Musacchio 1999). The geological environment around the southern portion of the Gulf is Tertiary (Panza et al. 1994). In it, the "Patagonian" environment ("Monte León Formation") has been assigned to the Paleogene (Eocene) (Panza et al. 1994). We consider that the age of the crater may coincide with either that of the "enigmatic package" ('Horizonte Madre'), or the Salamanca formation above it, or the pyroclastic Cretaceous rock level below the 'Horizonte Madre', and that some of these levels should contain the crater's ejecta. We have not been able to test these hypotheses. Seismic stratigraphy, and stratigraphic work in coastal San Jorge, as well as some coring in the

sea bottom of this region is necessary to elucidate this problem. Despite our current uncertainty in terms of chronology, given the colossal magnitude of this crater it must have had a large influence on climate and the environment. The flattened central rise and the relatively shallow ring that surrounds it suggest an old geological age for this crater. If it belongs, as we suspect, in the Cretaceous / Tertiary (K/T) boundary, it must have played a significant role in the massive extinction of biological species that characterize the K/T transition.

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